

MAPPING THE RELATIONSHIPS BETWEEN TRAIL CONDITIONS AND  
EXPERIENTIAL ELEMENTS OF LONG-DISTANCE HIKING

by

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## STATEMENT OF THESIS APPROVAL

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## ABSTRACT

Hikers who experience acceptable ecological trail conditions are more likely to act as trail stewards, set proper trail etiquette examples, and use low-impact practices. However, managers and researchers do not thoroughly understand the relationships between ecological trail conditions, preferences for trail conditions, and experiential elements of long-distance hiking. Therefore, the purpose of this study was to investigate how ecological trail conditions influence particular experiential elements of long-distance hiking on the Appalachian Trail. The researcher used a mixed-methods approach involving semi structured interviews ( $n = 17$ ), quantitative questionnaires ( $n = 336$ ), ecological measurements of trail conditions (734 miles of trail), and modified Recreation Suitability Mapping (RSM) to quantify the relationships between five trail conditions (trail incision, muddiness, rugosity, trail width, and gradient) and four elements of the long-distance hiking experience (level of challenge, perceived impact to the musculoskeletal system, valuation of trail tread aesthetics, and the ability to maintain an ideal hiking pace). The researcher weighted and analyzed hikers' preferences for trail conditions using SPSS 22.0, and mapped the resulting data using ArcMap 10.2.2. Results suggest that valuation of trail tread aesthetics was the most important element of the long-distance hiking experience, and that muddiness had the most influence on valuation of trail tread aesthetics. The modified RSM techniques used in this study provided an efficient means to compare trail sections and identify relationships between trail

conditions and experiential elements. The methods and results have implications for trail managers regarding the effects of trail conditions on the hiking experience, enhancement of the hiking experience, and construction and utilization of informative maps.

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## CHAPTER I

### INTRODUCTION

#### Thesis Format

This thesis was written in article format and includes three chapters. Chapter I is an introduction to the problem and describes the overall significance of the research. Chapter II is a journal article that is prepared for submission and includes a literature review, research questions, methods, results, and discussion. Chapter III provides an overview of insights gained through the thesis process, including challenges, successes, discoveries, and advice to students and researchers.

#### Introduction to the Problem and Overall Significance

Previous research indicates that the condition of a trail affects the hiking experience (Lynn & Brown, 2003) and that the quality of the hiking experience influences hikers' behavior towards the resource (Dorwart, Moore, & Leung, 2009). Specifically, if hikers have high-quality trail experiences they are more likely to adopt low-impact practices and act as trail stewards (McFarlane, Boxall, & Watson, 1998). Therefore, providing opportunities for high-quality hiking experiences is important to most trail managers (Driver & Tocher, 1970; Manfredi, Driver, & Brown, 1983). However, identifying specific locations where ecological conditions exist that contribute

to high-quality hiking experiences is often difficult.

Social-spatial mapping techniques like Recreation Suitability Mapping (RSM) mitigate this challenge and help identify and display the relationships between social and ecological conditions, landscape features, and elements of the outdoor recreation experience (for recent applications see Albritton & Stein, 2011; Beeco, Hallo, & Brownlee, 2014; Kliskey, 2000; Saqalli, Caron, Defourny, & Issaka, 2009; Silberman & Rees, 2010; Snyder, Whitmore, Schneider, & Becker, 2008; Wyman & Stein, 2010). Investigating these spatial relationships is important because ecological and experiential conditions should be studied together to understand reciprocal relationships (Manning, Leung, & Budruk, 2005; Moore, Smith, & Newsome, 2003; Newman, Marion, & Cahill, 2001). Understanding this reciprocity is critical to advancing the sustainability of long-distance hiking trails (Marion & Leung, 2001).

The relationships between trail conditions and experiential elements of long-distance hiking are not well understood, however, nor have they been mapped across multiple sections of a long-distance hiking trail using RSM techniques. This research aimed to fill this deficit by investigating the relationships between trail conditions and elements of the long-distance hiking experience on the northern section of the Appalachian Trail. Also, this study aimed to advance RSM methods for indexing, weighting, and spatially analyzing these relationships. Consequently, many of the methods employed in this study may be transferable to other restricted recreational corridors, such as pack stock trails and rivers used for rafting. Successfully indexing, mapping, and analyzing these relationships may thus provide useful information about relationships between ecological conditions and the outdoor recreational experience.

To accomplish this aim, a mixed-methods approach was employed involving semi

structured interviews ( $n = 17$ ), quantitative questionnaires ( $n = 336$ ), ecological measurements of trail conditions ( $n = 21$ -5km sections), and modified RSM techniques to quantify the relationships between five trail conditions (trail incision, muddiness, rugosity, trail width, and gradient) and four experiential elements of long-distance hiking (level of challenge, perceived impact to musculoskeletal system, valuation of tread aesthetics, and ability to maintain an ideal hiking pace). Quantified values were weighted and analyzed using SPSS 22.0, and mapped using ArcMap 10.2.2.

The modified RSM techniques used in this study provide an efficient means to compare the experiential quality of different trail sections and identify relationships between trail conditions and experiential elements of long-distance hiking. The methods and results have implications for trail managers interested in the influence of trail conditions on the hiking experience, enhancement of the hiking experience, and construction of informative maps. (To illustrate these implications several RSM-oriented maps are included throughout this document to emphasize practical management implications for the northern Appalachian Trail and beyond.)

### Overall Research Question

The research in this thesis addresses the following question:

How do specific trail conditions influence particular experiential elements of long-distance hiking? I addressed this overall question by investigating:

1. Which trail conditions influence particular experiential elements of long-distance hiking, and to what degree;
2. Which trail sections contain conditions that contribute to high- or low-quality hiking experiences;

3. The best social-spatial GIS techniques for indexing, weighting, and mapping the relationships between trail conditions and experiential elements of long-distance hiking;
4. How spatially mapping the relationships between trail conditions and experiential elements of long-distance hiking can inform trail improvement and maintenance.

## CHAPTER II

### MAPPING THE RELATIONSHIPS BETWEEN TRAIL CONDITIONS AND EXPERIENTIAL ELEMENTS OF LONG-DISTANCE HIKING

#### Abstract

Trail users that experience acceptable social and ecological conditions are more likely to act as trail stewards, exhibit proper trail etiquette behaviors, and use low-impact practices (Williams, Patterson, Roggenbuck, & Watson, 1992). However, the relationships between specific trail conditions and experiential elements of long-distance hiking are not well understood. Therefore, the purpose of this study was to identify how trail conditions influence particular elements of the long-distance hiking experience. The researcher used a mixed-methods approach involving semi structured interviews ( $n = 17$ ), quantitative questionnaires ( $n = 336$ ), ecological measurements of trail conditions ( $n = 21$ -5km sections), and modified Recreation Suitability Mapping (RSM) techniques to quantify the relationships between five trail conditions (trail incision, muddiness, rugosity, trail width, and gradient) and four experiential elements of long-distance hiking (level of challenge, perceived impact to musculoskeletal system, valuation of tread aesthetics, and ability to maintain an ideal hiking pace). Quantified values were weighted, analyzed, and mapped using SPSS 22.0 and ArcMap 10.2.2. The modified RSM techniques used in this study provide an efficient means to compare the experiential

quality of different trail sections and identify relationships between trail conditions and experiential elements of long-distance hiking.

### Introduction

Recreational trail use has been increasing for decades (Cole & Landres, 1996). In 1995, the National Survey on Recreation and the Environment reported that outdoor recreation participation was growing faster than the population (Cordell, Lewis, & McDonald, 1995), a trend that continues to this day (Outdoor Foundation, 2014). Specifically, in 2014, the Outdoor Foundation Recreation Participation Topline Report indicated that a record number of Americans participated in outdoor activities, including increased recreation on trails. With more people using trails, more ecological impacts are occurring, often resulting in undesirable trail conditions (Ballantyne & Pickering, 2015).

In response, trail managers continuously aim to design and maintain ecologically sustainable trail systems that feature trail conditions that users desire (Marion & Leung, 2001). This makes sense because land managers are charged with maintaining sustainable ecological and social conditions, and trails are resources that managers must protect (Monz, 2009). In turn, well-managed trails with desirable tread conditions positively influence the recreation experience, leading to satisfied users (Marion & Leung, 2001).

The importance of sustainable trails with desirable tread conditions extends beyond user satisfaction (Dorwart, Moore, & Leung, 2009). Quality tread conditions contribute to appreciation of nature, support for outdoor environments, and societal enjoyment (Manning, 2001). More specifically, trail users who encounter desirable conditions may adopt low-impact practices and act as stewards of the resource (McFarlane, Boxall, & Watson, 1998). Therefore, providing opportunities for high-



quality experiences based on desirable tread conditions is important to most trail managers (Driver & Tocher, 1970; Manfredo, Driver, & Brown, 1983).

One important group of trail users is long-distance hikers, who trek 500 miles or more during a single outing (Anderson et al., 2009, Pacific Crest Trail Association, 2015). Long-distance hikers are a heralded group that often serve as role models for other trail users (Littlefield & Siudzinski, 2012). If long-distance hikers encounter desirable trail conditions, they are likely to develop an affinity for the trail and practice proper trail ethics (Williams et al., 1992). Such high regard for the trail may influence other types of hikers (e.g., day hikers) who look to long-distance hikers as examples (Ptasznik, 2015). Therefore, understanding the relationships between trail conditions and the quality of long-distance hiking experiences is important to the larger hiking and trail management community.

Understanding where specific trail conditions contribute to high-quality long-distance hiking experiences can be difficult because social data (e. g., preferences for trail conditions) are often not assigned a specific geographic location (Beeco, Hallo, & Brownlee, 2014). Recreation Suitability Mapping (RSM) is a technique that makes it possible to identify and display the relationships between social preferences, ecological conditions, and landscape features (for recent applications see Albritton & Stein, 2011; Beeco et al., 2014; Kliskey 2000; Saqalli, Caron, Defourny, & Issaka, 2009; Silberman & Rees, 2010; Snyder, Whitmore, Schneider, & Becker, 2008; Wyman & Stein, 2010). Investigating these spatial relationships is important because ecological and social preferences should be studied together to understand reciprocal associations (Manning, Leung, & Budruk, 2005; Moore, Smith, & Newsome 2003; Newman, Marion, & Cahill 2001). Understanding this reciprocity is critical to advancing the sustainability

of long-distance hiking trails (Marion & Leung, 2001).

This reciprocity between trail conditions and experiential elements of long-distance hiking is not well understood, however, nor has it been mapped across multiple sections of a hiking trail using RSM techniques. Better understanding how trail conditions influence long-distance hiking experiences at a specific location could provide managers with information for trail routing and maintenance. Mapping the relationships between trail conditions and experiential elements of long-distance hiking may also provide managers with concise information that they can access more easily and efficiently than using other approaches. Therefore, the purpose of this study was twofold: 1) to examine which trail conditions influence particular experiential elements of long-distance hiking, and to what degree; and 2) to index, map, and analyze these relationships using modified RSM techniques.

### Literature Review

The literature review has three sections and provides background on trail conditions, experiential elements of long-distance hiking, and associated RSM techniques. The first section focuses on trail conditions that are often of interest to researchers, managers, and trail users, particularly hikers. The second section describes four experiential elements of long-distance hiking that researchers have previously investigated, are potential motives for participation, and are likely influenced by trail conditions. The third section of the literature review explores Recreation Suitability Mapping (RSM), a Geographic Information System (GIS)-oriented tool that researchers and managers use to map the relationships between ecological conditions and social preferences for important recreation landscapes.

## Trail Conditions

The trail conditions included in this study were trail incision (trail depth), muddiness, rugosity (roughness), width, and gradient (degree of slope) (see Figure 1). The researcher chose these conditions based on review of the literature, and because these conditions reflect common trail impacts and/or hiking difficulty on long-distance trails. Furthermore, hikers are generally aware of these conditions without the need for additional education and explanation. In the following section, these five trail conditions are defined, their measurement is highlighted, and their potential influence on the hiking experience is described.

Trail incision is the depth of the main tread in relation to the sides of the trail (Marion & Leung, 2001). Researchers and managers generally measure incision by temporarily positioning a transect line that is perpendicular to the trail tread. The transect line is attached to stakes placed at the trail borders and configured vertically to represent the post-construction, pre-use tread surface (Marion, Leung, & Nepal, 2006). Trail incision is the maximum measurement taken from the transect line to the lowest point of the trail (Marion et al., 2006). Incision correlates with soil loss caused by wind and water erosion, compaction, and soil displacement (Olive & Marion, 2009). Significant soil loss can cause hikers to wander laterally, widening the trail and causing greater vegetation and soil loss over time (Bryan, 1977; Wimpey & Marion, 2010).

Muddiness occurs on flat sections of trail that retain water and where the terrain lacks drainage (Marion & Leung, 2001; Nepal, 2003). Muddiness can be measured by identifying the lineal extent of the muddy area using a measuring wheel (Moore, Leung, Matisoff, Dorwart, & Parker, 2012). Muddiness may cause hikers to circumnavigate the muddy area, which can result in trail widening and/or vegetative trampling to avoid the

mud (Marion, 1994). Muddiness may also increase the difficulty of travel, particularly in relation to hiking speed and stability.

Rugosity is the roughness of the trail tread, generally caused by soil loss, exposed rocks and roots in the tread that contribute to increased rugosity and hiking difficulty (Wimpey & Marion, 2010). Researchers and managers measure rugosity using a three-step process. First, stakes and a transect line are configured as described for the trail incision measurement (Olive & Marion, 2009). Second, at fixed intervals (e.g., 10cm) vertical measurements are taken from the transect line to the tread surface (Wimpey & Marion, 2010). Third, the variance of these vertical measurements is calculated as a measure of tread rugosity (Wilson & Seney, 1994; Wimpey & Marion, 2010). Rugosity often causes hikers to seek smoother terrain, which means possibly hiking away from the tread to avoid rough areas (Wimpey & Marion, 2010). Rugosity can slow and distract hikers because they must be cognizant of foot placement to avoid rocks and roots that increase the chance of tripping and falling (Moore et al., 2012).

Trail width is the gap in vegetation growth where the trail resides and is central to supporting trail traffic (Wimpey & Marion, 2010). Trail width can be measured with a standard tape measure extended across the trail tread from boundaries defined by visually obvious trampling disturbance (Dale & Weaver, 1974). Excessive trail width means there is a larger areal extent of impact to vegetation, organic litter, and soil, possibly decreasing the aesthetics of the trail (Wimpey & Marion, 2010).

Trail gradient is the slope or grade of the trail (National Park Service, 2015) and is typically measured as rise/run (Wimpey & Marion, 2011). Researchers and managers generally use a clinometer to measure trail gradient (Sutherland, Bussen, Plondke, Evans, & Ziegler, 2001). As trails become steeper, they typically experience greater erosion, due

to the increasing velocity of water runoff (Farrell & Marion, 2001; Olive & Marion, 2009). The rockiness and exposed roots on particularly steep trails causes hikers to move laterally to find the easiest route (Wimpey & Marion, 2010). Most hikers indicate that trails with steep grades are generally more challenging (Zealand, 2007). These five trail conditions, except of trail gradient, are direct impacts born from recreational use (Lynn & Brown, 2003) (Figure 1). The relative prevalence and degree of these five trail conditions likely affect the quality and challenge of hiking experiences (Lynn & Brown, 2003). Furthermore, these trail conditions could influence overall recreational quality and satisfaction more than other factors, such as crowding (Floyd, Jang, & Noe, 1997).

#### Experiential Elements of Long-Distance Hiking

Informed by the literature, the researcher selected four experiential elements of long-distance hiking: level of challenge, perceived impact to the musculoskeletal system, valuation of tread aesthetics, and hiking pace. According to Mueser (1998), challenge is testing one's physical ability and self-esteem, and is the primary reason for long-distance hiking. Establishing predetermined distance goals is part of the process that hikers use to challenge themselves (Kil, Stein, & Holland, 2014). The challenge of a long-distance hike is unmatched and unusual, and according to Mueser (1998), "successfully meeting the challenge is rewarded by a rare sense of accomplishment" (p. 8). The challenge of a long-distance hike involves enduring physical and mental trials for extended periods of time (Zealand, 2007). However, hikers may perceive level of challenge differently, depending on personality characteristics and previous experiences (Zealand, 2007). Level of challenge can also be different when comparing numerous trail sections, as is the case when comparing diverse trail sections that contain varying terrain and trail conditions

(Appalachian Trail Conservancy, 2015).

The musculoskeletal system supports and binds tissues and organs together using bones, muscles, tendons, ligaments, and cartilage (Hamerman, 1997). Impact to the musculoskeletal system is paramount to the hiking experience, because injuries to the musculoskeletal system can slow or stop a long-distance hike. Injuries to the musculoskeletal system include fractures, joint pain, sprains, and strains (Boulware, 2004). Anderson et al., (2009) states that “musculoskeletal injuries represent a significant source of morbidity among long-distance hikers” (p. 252). Long-distance hikers are high risk for impacts to the musculoskeletal system due to carrying substantial loads and provisions in their backpacks (Knight & Caldwell, 2000). Previous research has demonstrated that increased backpack loads produce greater knee and trunk flexion with each step (Han, Harman, Frykman, Johnson, & Rosenstein, 1993). Al-Khabbaz, Shimada, and Hasegawa (2008) agree that carrying a backpack leads to changes in trunk posture, which may contribute to undesirable symptoms, such as back pain. Heavier loads also mean more downward force with each step experienced by the joints (Kuster, Sakurai, & Wood, 1995; Pierrynowski, Norman, & Winter, 1981; Simonsen, Dyhre-Poulsen, Voigt, Aagaard, & Fallentin, 1997). Tricky terrain, especially steep downhill or trail sections with high rugosity, may increase impacts to the musculoskeletal system.

Valuation of trail aesthetics is an important element of the hiking experience because the trail tread is always visually present. For the purpose of this study, the researcher evaluated preferences for ‘tread aesthetics’, not the overall aesthetics that surround the trail corridor, which may include vistas, amount and type of vegetation, and color variation. Researchers have found that degradation of trail conditions may decrease tread aesthetics and the experiential quality of recreational activities (Vaske, Graefe,

Dempster, & Boteler 1983). Visually offensive tread conditions can lower the functional value of the trail and thus influence the experience (Marion & Leung, 2001). Naber (2008) agrees that trail impacts, such as incision, can decrease tread aesthetics, and change hiker behavior.

Finally, maintaining an ideal hiking pace is important to the completion of long-distance hikes. The completion date of the hike is important to avoid undesirable seasonal weather, particularly in northern sections of long-distance hiking trails. Hiking pace is also critical in regards to daily food consumption so that resupply points are reached in a timely manner (Mueser, 1998). Degraded conditions typically compromise a hiker's pace, and consequently the hiker may not complete the hike or reach resupply points within the allotted times (Wagtendonk & Benedict, 1980).

### Spatial Mapping

This section of the literature review focuses on Recreation Suitability Mapping (RSM), which is a GIS approach that models landscape features to identify areas most suitable for specific recreation activities (Kliskey, 2000). RSM quantifies areas of recreational worth by identifying and weighting social preferences for conditions that can be mapped (Kliskey, 2000). For example, a bird watcher may prefer a landscape with specific vegetation and a certain percent of tree cover, while a landscape photographer may prefer open vistas. Such preferences for varying conditions can be mapped and displayed to inform decisions regarding recreation activity zoning and to assess the suitability of an area for specific activities. Some examples of resource conditions mapped by researchers and managers are topography, soil types, vegetation type and density, proximity to water, and wildlife habitat (Beeco et al., 2014; Kliskey, 2000).

Ultimately, RSM techniques provide a greater understanding of resource and terrain conditions and how resource conditions may affect recreational experiences (Beeco, Hallo, & Giumetti, 2013).

RSM is well suited for efficiently analyzing the interaction between place and experience by displaying numerous map layers on a single map depicting where significant place-experience interactions occur. Researchers and managers often increase the transparency of numerous map layers, allowing for identification of overlapping attributes. The transparency of layers makes it relatively straightforward to sift through large amounts of data for patterns and anomalies that may lead to decisions regarding appropriate uses for an area (Goodchild, Anselin, Appelbaum, & Harthorn, 2000).

Relationships between landscape features, trail conditions, resource attributes, and experiential elements of the recreation experience can be indexed, weighted, and spatially embedded into GIS layers using procedures outlined by Beeco and others (2014).

Generally, RSM methods include four primary steps: 1) identify and map terrain and ecological conditions deemed important to the recreation activities of interest; 2) identify social preferences for these conditions using quantitative questionnaires administered to representative samples of the recreation activity groups of interest; 3) scale and weight the relationships between ecological conditions and social preferences; and 4) display and analyze the resulting relationships using GIS techniques (Beeco et al., 2014). This 4-step process produces maps that clearly identify the relationships between resource conditions and overall experiential values.



### Research Questions

The following research questions guided the investigation of the relationships between trail conditions and experiential elements of long-distance hiking. The aim was to use answers to these research questions to a) help trail managers evaluate and ensure high-quality hiking experiences, and b) advance future RSM research by identifying optimal methods to index, map, and analyze relationships between ecological conditions and social preferences within restricted recreational corridors (e. g., long-distance hiking trail, river for rafting, trail for pack stock).

1. Which trail conditions influence particular experiential elements of long-distance hiking, and to what degree?
2. Which sampled trail sections contain conditions that contribute to high- or low-quality hiking experiences?
3. What are the best social-spatial GIS techniques for indexing, weighting, and mapping the relationships between trail conditions and experiential elements of long-distance hiking?
4. How may spatially mapping the relationships between trail conditions and experiential elements of long-distance hiking inform management decisions regarding trail improvement and maintenance?

### Description of Research Location

The Appalachian Trail (AT) is located in the eastern United States, extending from Springer Mountain in Georgia to Mount Katahdin in Maine (2,200 miles), and passing through 14 states (Appalachian Trail Conservancy, 2015) (Figure 2). The National Park Service manages the AT in partnership with the Appalachian Trail

Conservancy (ATC) and 31 trail clubs responsible for trail management and maintenance (Appalachian Trail Conservancy, 2015). Approximately 2 to 3 million people use the AT annually for a wide variety of hiking activities, such as ‘thru-hiking’, which is the process of hiking the entire trail in a single outing (Appalachian Trail Conservancy, 2015). The northern AT, spanning 734 miles from the New York-Connecticut border to the northern terminus at Mount Katahdin in Maine, was the study area for this research. The northern AT passes through Connecticut, Massachusetts, Vermont, New Hampshire, and Maine. The Connecticut section of the AT is 51.6 miles, with elevation ranging from 260 to 2,316ft (Appalachian Trail Conservancy, 2015), while the AT section in Massachusetts is 90.2 miles, with elevation ranging from 650 to 3,491ft. In Vermont the AT passes through rugged terrain along the crest of the Green Mountains (149.8 miles long, with elevation ranging from 400 to 4,010ft). The New Hampshire section of the AT passes through the White Mountains, which features the most miles above tree line compared to any other AT state (Appalachian Trail Conservancy, 2015). This section is 160.9 miles, with elevation ranging from 400 to 6,288ft. The AT in Maine is 281.4 miles, with elevation ranging from 490 to 5,267ft.

### Methods

As a guiding framework, the researcher selected an exploratory mixed methodology design (Clark & Creswell, 2011) with three connected phases (i.e., Exploratory Sequential Design). In Phase 1, the researcher conducted interviews with AT long-distance hikers to identify important experiential elements that aligned with the literature. In Phase 2, the researcher developed, piloted, and administered a questionnaire for AT long-distance hikers. Also in Phase 2, the researcher measured and assessed

ecological trail conditions on the Northern AT. In Phase 3, the researcher indexed, weighted, analyzed, and displayed the relationships between trail conditions and experiential elements of long-distance hiking using ArcMap software. This sequential process was selected because a) not all quantitative measures or instruments for the phenomenon under investigation were available, b) some variables were unknown, and c) due to the novelty of the investigation, numerous frameworks or theories were applicable (Clark & Creswell, 2011; Morgan, 1998).

### Phase 1 – Initial Interviews

The researcher conducted semi structured phone interviews with long-distance AT hikers using a modified Seidman (2012, p.21) approach during February of 2015 ( $n = 17$ ;  $M_{minutes} = 45$ ). The researcher used nonprobability convenience sampling to initially locate interview participants, and used a snowball sampling approach to identify subsequent participants. The sample consisted of 13 males and four females ranging from young adults to seniors. The researcher audio-recorded the interviews, and used standard coding procedures outlined by Saldaña (2012) to identify and verify the most important experiential elements of long-distance hiking that aligned with the literature (see interview questions in Appendix A). Similar to the prevailing literature, the interviews revealed that challenge, perceived impact to the musculoskeletal system, trail tread aesthetics, and hiking pace were important experiential elements for AT long-distance hikers.

## Phase 2 – Instrument Development and Data Collection

Using Phase 1 results and relevant literature, the researcher developed measurement items that captured long-distance hikers' preferences for trail conditions and experiential elements of long-distance hiking. Following procedures outlined by Beeco and others (2014), the researcher used a) 9-point Likert scales to assess the preference of trail conditions for each experiential element of long-distance hiking (1 = do not prefer; 9 = highly prefer), b) rank order questions to identify the trail condition most influential for each experiential element, c) 9-point Likert scales that captured the importance of each experiential element (1 = not important at all; 9 = extremely important), and d) a rank order question assessing how important each experiential element was to the overall AT experience. In addition to these measures, the researcher adapted previously validated items to measure a) hikers' Experience Use History, or the degree of previous hiking experience (Schreyer, Lime, & Williams, 1984), and b) standard demographics (U.S. Census Bureau, 2015). The researcher combined these measures into a 5-page, paper-based, anonymous questionnaire.

The researcher used photographs depicting trail conditions as part of the questionnaires to help respondents understand and visualize the trail conditions central to this study (i. e., trail incision, muddiness, rugosity, width, and gradient). The researcher used photographs because visual methods more effectively depict varying resource conditions than narrative descriptions (Manning & Freimund, 2004). An initial pool of trail condition photographs ( $n = 30$ ) was selected from actual trail condition photos taken on the Northern AT (photographs from Marion, 2015). To select the most appropriate photo for each trail condition, the researcher used a q-sort process (Fairweather & Swaffield, 2000; Pitt & Sube, 1979) where hikers ( $n = 9$ ) were provided with written

descriptions of trail conditions derived from the literature (Lindhagen & Hörnsten, 2000), and asked to select the photo that best matched the description.

Following the q-sort of photographs, experts ( $n = 3$ ) reviewed the final selected photos ( $n = 6$ ; one for each trail condition) and the questionnaire for content validity, sequencing, and item clarity (suggested edits incorporated). In the final step, the researcher conducted a pilot study with hikers ( $n = 17$ ) to assess the overall clarity of the questionnaire and congruency with photographs. The results of the expert review and pilot study allowed the researcher to slightly adjust item wording and question sequencing.

The researcher administered the questionnaire using systematic random probability sampling (Vaske, 2008) at the Trail Days Festival in Damascus, Virginia in May 2015. This sampling location was deemed ideal because Trail Days is focused on the AT, popular with past and present long-distance AT hikers, and is the largest annual gathering of AT enthusiasts in the world (Trail Days, 2016). The researcher administered questionnaires to hikers who a) had hiked 500 AT miles or more in a single outing, or b) were currently hiking the AT with the intention of hiking 500 miles or more.

Following the questionnaire administration, the researcher assessed trail conditions for 21, 5-km sections on the Northern AT (Figure 3). The researcher selected trail sections using the Generalized Random Tessellation Stratified approach (GRTS), which is a spatially balanced sampling approach with a true probability design dependent on location (Lister & Scott, 2009; Stevens, 2006; Stevens & Olsen, 2003). Within each section, GRTS was used to identify 50 transect points for trail condition assessments, which were field located using a handheld Garmin 64 GPS unit.

At each transect point ( $N=1050$ ), the researcher assessed a) maximum trail

incision following procedures outlined by Marion and others (2006), b) muddiness using the percent of each trail transect containing mud (Marion & Leung, 2001), c) rugosity by calculating the variance of cross-sectional verticality across the trail (Wilson & Seney, 1994; Wimpey & Marion, 2010), and d) trail width (Dale & Weaver, 1974). The researcher used *Google Earth* to identify the amount of uphill and downhill in each of the 21 sections in the northbound direction, because the northbound direction is the most popular hiking direction for AT long-distance hikers (Appalachian Trail Conservancy, 2015).

### Phase 3 – Indexing Variables and Mapping

The researcher used two steps in the social-spatial mapping process: 1) weighting variables in SPSS 22.0 and EQS 6.1, and 2) mapping and analyzing the relationships in ArcMap 10.2.2. Specifically, the researcher adapted and augmented weighting procedures outlined by Beeco and others (2014) and Kliskey (2000). Ultimately, each trail section received scores for specific trail conditions, each experiential element of long-distance hiking, and the overall experience using the procedures described below.

### Weighting Variables

The researcher developed two variable weights adapting previous weighting procedures described by Beeco and others (2014) and Kliskey (2000). The first weight ( $W_1$ ) captured the contribution of hikers' preferences for each trail condition (incision, muddiness, rugosity, width, uphill, and downhill) relative to each experiential element of long-distance hiking (level of challenge, perceived impact to musculoskeletal system, valuation of tread aesthetics, and ability to maintain an ideal hiking pace). For example, a

hiker may have preferred a rough trail over a wide trail to experience challenge or a wide trail more than an incised trail to maintain an ideal hiking pace. The second weight ( $W_2$ ) ranked the contribution of hikers' preference for each experiential element of long-distance hiking relative to the overall hiking experience. For example, a hiker may have preferred challenge more than tread aesthetics when determining the quality of their overall hiking experience, or prefer an ideal hiking pace more than experiencing a challenge. The following equations were used to produce  $W_1$  and  $W_2$ . The contribution of each trail condition to each experiential element was derived from:

$$W_1 = (\lambda) (\bar{x}) (tc_r), \text{ and } Z_{ss_{ee}} = \Sigma (W_1 * Z_{tc}), \text{ where}$$

- $\lambda$  = factor loading for each trail condition related to each experiential element
- $\bar{x}$  = mean preference for each trail condition related to each experiential element
- $tc_r$  = percent rank for each trail condition related to each experiential element
- $Z_{tc}$  = z-scores for level of existence of each trail condition within each trail section
- $Z_{ss_{ee}}$  = z-score for each experiential element for each trail section

The contribution of each experiential element to the overall experience was produced using

$$W_2 = (\lambda) (\bar{x}) (ee_r), \text{ and } Z_{ss_{oe}} = \Sigma (W_2 * Z_{ss_{ee}}), \text{ where}$$

- $\lambda$  = factor loading for each experiential element related to the overall trail experience
- $\bar{x}$  = mean preference for each experiential element related to the overall trail experience
- $ee_r$  = percent rank for each experiential element related to the overall trail experience
- $Z_{ss_{ee}}$  = z-score for each experiential element for each trail section
- $Z_{ss_{oe}}$  = z-score for overall experience for each trail section

The factor loadings ( $\lambda$ ) in these equations were computed using a formative Confirmatory Factor Analysis (CFA) using EQS 6.1, and were used because a) each experiential element was considered a latent unobserved variable (e. g., 'challenge')

influenced by observed trail conditions (e. g., ‘rugosity’); b) hikers perceived that each trail condition had a different influence on each experiential element; c) the multivariate position of the ‘overall experience’ variable was unknown and approximated by different levels of experiential element variables (Kline, 2011; Noar, 2003); and d) factor loadings were an effective mechanism to represent different contributions from observed variables and first-order latent variables to second-order variables (DiStefano, Zhu, & Mindrila, 2009). Overall, these weighting procedures produced scores that represented each trail section’s capacity to provide a ‘preferable overall experience’ relative to desirable trail conditions that contributed to challenge, aesthetics, pace, and limited impact to musculoskeletal system.

### Mapping

The researcher imported these weights into ArcMap 10.2.2 along with the locations of the 21 sections sampled and the AT centerline. Next, trail section scores were then classified using Jenks Natural Breaks and subsequently color coded, which depicted a color code for each trail section determined by weight. Jenks Natural Breaks is a classification method that arranges clustered data into different classes by reducing the variance within classes and maximizing the variance between classes (Jenks, 1963). The final map included five weighted layers for each trail section, comprised of a layer for each of the four experiential elements of long-distance hiking, and one aggregate layer for the overall experience scores.



## Results

### Description of the Sample

During sampling, 336 long-distance hikers completed the questionnaire with a response rate greater than 70%, yielding 5.26% confidence interval at the 95% confidence level, used as a representative sample of AT long-distance hikers. The researcher used standard calculations for leverage, kurtosis, and skewness to identify statistical outliers and to verify univariate and multivariate normality of the data (Tabachnick, Fidell, & Osterlind, 2001). One case was excluded from subsequent analysis due to extreme violations of multivariate normality identified using  $\chi^2$  bounds derived from the Mahalanobis Distance Equation (Tabachnick et al., 2001).

The majority of respondents reported residing in the United States (97.0%), specifically within the Eastern Time Zone (73.0%), with the highest representation coming from Virginia and North Carolina (8.0% respectively). The average age of respondents was 32 years. The majority of the sample was male (71.3%) with limited differences in respect to race (90.5% self-identified as white). The sample had varying educational backgrounds: 28% received some college, and 38.4% reported receiving a 4-year college degree. Over one-third (38.7%) reported making less than \$24,999 in household income annually (not adjusted by census region or state). On average, the sample reported hiking 618 miles in the last 12 months, and 2,441 miles during their lifetime.

### Trail Conditions

The trail conditions in each section are displayed in Table 1. One way ANOVA results and chi-square distributions were evaluated to identify the variability of trail

conditions across trail sections. Significant differences exist in the scores and distributions across all sections ( $p < 0.05$ ), indicating that trail conditions vary significantly across sampled trail sections.

### Results of Relationships between Variables

Results addressing Research Question 1 (Which trail conditions influence particular experiential elements of long-distance hiking, and to what degree?) are displayed in Figure 4. Although, long-distance hikers felt all four experiential elements were important ( $M_{importance}$  ranged from 6.33 to 8.34 out of 9), sampled hikers ranked tread aesthetics as being the most important experiential element. Specifically, tread aesthetics was ranked by 50.2% of long-distance hikers as the most important experiential element to the overall experience. Tread aesthetics displayed a high mean importance (8.34 out of 9) with a low standard deviation (1.01), suggesting that long-distance hikers agree that tread aesthetics was highly important. Mud (38% degree of influence) and incision (25% degree of influence) were reported by long-distance hikers as the trail conditions that negatively influenced tread aesthetics the most.

Long-distance hikers found level of challenge important to the overall experience as well. Challenge was ranked by 38.5% of long-distance hikers as being the most important experiential element to the overall experience, and received a mean importance score of 7.69 ( $\pm 1.72$ ). Different from tread aesthetics, uphill grade (59%) and rugosity (32%) were reported by long-distance hikers as the trail conditions that positively contributed to challenge the most. Conversely, and logically, width (<1%) had the smallest influence on challenge.

Perceived impact to the musculoskeletal system was shown to have little

influence on the overall experience; only 6.1% of long-distance hikers ranked impact as the most important experiential element to the overall experience, but most agreed that impact held some importance ( $M_{importance} = 7.07$ ; s.d. = 1.86). Regarding the trail conditions that influenced impact the most, long-distance hikers reported that downhill (45%) and rugosity (29%) were quite influential.

The ability to maintain an ideal hiking pace was reported to be the least influential experiential element to the overall experience. Only 5.2% of long-distance hikers ranked pace as being the most important experiential element, and pace received a moderate mean importance score ( $M_{importance} = 6.33$ ; s.d. = 2.01). The larger standard deviation for pace suggests high variation and potential disagreement about the importance of pace. Rugosity (29%) and mud (28%) were reported as the top two trail conditions that influenced pace.

### Section Scores for Experiential Elements and Overall Experience

Results displayed in Table 2 address Research Question 2 (which sampled trail sections contain conditions that contribute to high- or low-quality hiking experiences). Table 2 also notes which sections had the highest and lowest scores for each experiential element and the overall experience. Table 2 was imported into ArcMap 10.2.2 to produce map layers shown in Figures 5 to 9. Figure 5 displays section scores for level of challenge, Figure 6 displays section scores for valuation of tread aesthetics, Figure 7 displays section scores for the ability to maintain an ideal hiking pace, Figure 8 displays section scores for perceived impact to the musculoskeletal system, and Figure 9 displays section scores for overall experience.

### Level of Challenge

Section 9 received the highest score for level of challenge (6.65).<sup>1</sup> Section 11 received the lowest score (2.74).<sup>2</sup> Sections 3 and 9 received ‘highly preferable’ scores and sections 10 and 11 received ‘not preferable’ scores (Table 2, Figure 5).

### Valuation of Tread Aesthetics

Section 14 received the highest score for tread aesthetics (5.57),<sup>3</sup> and Section 9 received the lowest score (1.61).<sup>1</sup> Sections 1, 11, 14, 17, and 19 received ‘highly preferable’ scores and sections 3 and 9 received ‘not preferable’ scores (Table 2, Figure 6).

### Ability to Maintain an Ideal Hiking Pace

Section 11 received the highest score for ability to maintain an ideal hiking pace (5.61),<sup>2</sup> and similar to tread aesthetics, Section 9 received the lowest score (1.53).<sup>1</sup> Sections 1, 10, 11, 14, and 21 received ‘highly preferable’ scores and sections 3, 9, and 15 received ‘not preferable’ scores (Table 2, Figure 7).

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<sup>1</sup>Section 9 received the highest score for challenge, and the lowest scores for aesthetics, pace, and overall experience

<sup>2</sup> Section 11 received the lowest score for challenge, and the highest score for pace

<sup>3</sup> Section 14 received high scores for aesthetics, impact, and overall experience

### Perceived Impact to the Musculoskeletal System

Section 14 received the highest score for perceived impact to the musculoskeletal system (5.46).<sup>3</sup> Section 3 received the lowest score (2.27). Sections 4, 7, 11, and 14 received ‘highly preferable’ scores and sections 3, 9, 13, 15, and 18 received ‘not preferable’ scores (Table 2, Figure 8).

### Overall Experience

Section 14 received the highest score for overall experience (5.90),<sup>2</sup> which is a function of high scores for aesthetics, impact, and overall experience. Section 9 received the lowest score (2.12).<sup>1</sup> Sections 1, 11, 14, 17, and 19 received ‘highly preferable’ scores and sections 2, 3, 9, and 13 received ‘not preferable’ scores (Table 2, Figure 9).

### Discussion

Although researchers have tangentially explored the relationships between trail conditions and experiential elements of long-distance hiking, researchers have not investigated and mapped these relationships over 734 miles of a long-distance hiking trail. This research addressed this gap by evaluating the relationships between trail conditions and experiential elements of long-distance hiking on the northern section of the AT. The modified RSM techniques used in this study appear to provide an efficient means to compare the experiential quality of different trail sections and identify

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<sup>1</sup>Section 9 received the highest score for challenge, and the lowest scores for aesthetics, pace, and overall experience

<sup>2</sup> Section 11 received the lowest score for challenge, and the highest score for pace

relationships between trail conditions and experiential elements of long-distance hiking. The methods and results have implications for trail managers interested in the influence of trail conditions on the hiking experience, enhancement of the hiking experience, and construction of informative maps, which are discussed in this section. In addition, this discussion addresses Research Question 3 (What are the best social-spatial GIS techniques for indexing and mapping relationships between trail conditions and experiential elements of long-distance hiking?) and Research Question 4 (How may spatially mapping the relationships between trail conditions and experiential elements of long-distance hiking inform management decisions regarding trail improvement and maintenance?).

#### GIS Techniques for Indexing and Mapping

The methods used to index and map the social-spatial relationships in this research advanced the RSM techniques previously used by Beeco et al. (2014) and Kliskey (2000). The modified RSM methods developed in this study reveal information for restricted recreational corridors, such as a hiking trail. The 2-weight method employed in this study was critical towards understanding data.

The first weight helped assign scores to trail sections for each experiential element of long-distance hiking. The resulting information after applying the weights suggests what particular type of experience is likely for each trail section, considering the presence of trail conditions. For example, section 11, located in southern Massachusetts, received the highest score for pace (Table 2, Figure 7). This section is most likely a section where maintaining an ideal hiking pace is possible. Moreover, since mud and rugosity influence pace the most (Figure 4), sections with a high pace score likely have

little mud and rugosity. Likewise, Section 9 received the lowest score for pace. This section had higher amounts of mud and rugosity (Table 1).

The second weight, which helped identify overall experience scores, reveals long-distance hikers' potential overall preference levels for a particular section. The analysis of this information helps highlight specific trail sections that may contribute to high-quality hiking experiences. For example, section 14 received the highest overall experience score, and the highest aesthetics score, and the most important experiential element to long-distance hikers was aesthetics. Since section 14 received the highest score for aesthetics, this caused this section to receive the highest score for overall experience. This relationship can further be analyzed (using Figure 4) to see which trail conditions are most influential to aesthetics (mud and incision).

These modified RSM techniques may be transferable to other restricted recreational corridors once social and ecological conditions are determined and quantified with questionnaires. For example, these methods may be transferable to other trails, such as the Pacific Crest Trail (PCT), by first identifying important social and ecological variables, quantifying the relationships between those social and ecological variables, and measuring ecological conditions. Once mapped, this information could show the locations for scores of experiential elements and the overall experience that are unique to the PCT.

Likewise, the same could be done for other restricted recreational corridors that are not hiking-centric. For example, a river for rafting might benefit from these methods to show how the experience changes along a river corridor. Again, once the relationships between salient social and ecological variables that are unique to that corridor are quantified, and ecological conditions measured, then this information could be mapped to

produce scores for experiential elements and the overall experience along the river corridor. Although this study evaluated the relationships between trail conditions (e. g., mud) and experiential elements of hiking (e. g., pace), the variables on a river may be quite different. For example, rafters may prefer rapids less than 0.5 miles long and the presence of vertical cliffs for viewing, which are both conditions that can be mapped. Using the weighting procedures described in this study, it would allow researchers and managers to identify specific locations where rapids less than 0.5 miles long and vertical cliffs contribute to high-quality rafting experiences. The resulting map layers for this simple example would display how experiential conditions may change by location, enabling researchers and managers to identify the change in experiential qualities along a restricted recreational corridor.

This research labeled sections that were 5-kilometers in length with scores for each experiential element and for the overall experience. It is important for management to understand that these scores are grounded in preference data from a representative group of long-distance hikers. Not all hikers are going to have the same preferences for trail conditions or particular experiential elements. Furthermore, the researcher labeled entire 5-kilometer sections. Trail conditions can vastly vary throughout a 5-kilometer section of trail, and thus the hiking experience might fluctuate across a 5-kilometer section. However, the modified RSM methods employed allow for the researcher to decide the distance of sections to be analyzed, from small increments to large increments.



### Management Implications

Spatially mapping the relationships between trail conditions and experiential elements of long-distance hiking is necessary for trail sustainability. The sustainability of trails is not solely about trail design; it is also important for managers to understand how the condition of the trail influences the quality of the hiking experience. When hikers have a high-quality overall experience, they are more inclined to partake in low-impact practices towards the resource (Williams et al., 1992).

The methods used in this research provide section scores and maps that show how trail conditions influence hiking quality, and how the experience may possibly change depending on location. Resulting map layers identify experiential differences between sections. The locations of problematic experiential elements are easy to identify using the map layers. It is possible to then identify problematic trail conditions in these sections. We suggest that trail managers should also consider these experiential factors when making decisions about which trail conditions should be addressed through trail relocation, reconstruction, or maintenance actions.

All of this information is evident when using the methods described in this research to map the relationships between trail conditions and experiential elements of long-distance hiking. These relationships are spatially precise and spatially explicit, allowing managers to quickly retrieve pertinent information regarding these areas. Managers can then use the map layers to analyze the scores for each experiential element, the overall experience, and use the data in the results to understand the influence of trail conditions.

The researcher imported both weights into ArcMap computer software to create five map layers: one layer for each experiential element of long-distance hiking ( $W_1$

scores), and a layer for overall experience ( $W_2$  scores). Using the map and its associated layers, managers can quickly view and evaluate these layers to compare scores for trail sections across each experiential element and the overall experience. Managers can analyze specific trail sections to see how experiential elements influenced the overall experience. Then using information in the results (such as Figure 4), managers can determine a) the extent that trail conditions are present in each section; b) the level of influence of trail conditions on each experiential element; and c) the level of influence each experiential element had on the overall experience. For example, using the map and its layers, researchers and managers could initially view a section's overall experience score. Next, the manager could visually review each experiential element map layer for that trail section to analyze how that section scored for particular experiential elements to gain an understanding of which experiential outcomes are more likely for that section. Then using information in the results (Figure 4), managers can determine how the presence and the extent of trail conditions influenced that specific section.

This information is spatially precise and managers can use it to understand the exact location of trail conditions. Managers can make trail improvement strategies for trail design, maintenance, or trail rerouting from the information in this research. For example, using this information, a manager can send a trail crew to a specific location to conduct maintenance on specific trail conditions. Managers could also use this information to direct hikers to specific sections, depending on the experiential outcome the hiker is seeking. Lastly, managers could include this information in guidebooks to provide information of the locations most suitable for particular hiking experiences.

Managers can use these results to design trails for specific elements of the hiking experience. For example, if managers design a trail for challenge, then the trail should

contain substantial elevation gain/loss and rough terrain. Managers might choose different goals for specific trails depending on location, such as backcountry or front country settings. The information in Figure 4 enables trail managers to design trails for particular purposes. In addition, Figure 4 also shows evidence of which experiential elements are most important to long-distance hikers.

The methods discussed in this research also have direct research implications that are helpful specifically to AT managers. This information combined with trail condition surveying for any AT section, regardless of location, is necessary to map experiential values. Constructed maps will show experiential values for that region.

#### Detailed Discussion of Sections 9 and 14

Trail sections 9 and 14 warrant additional discussion. These two sections had extreme scores for some elements of the hiking experience and overall experience scores. Specifically, section 9, located the furthest south in Maine in Grafton Notch State Park, received the lowest preferability score. Conversely, section 14, located the furthest north in Maine in Baxter State Park, received the highest score for overall preferability.

As seen in the results, the Grafton Notch State Park section received the highest score for level of challenge, but received the lowest score for valuation of tread aesthetics, maintaining an ideal hiking pace, and overall experience. It is interesting that even though this section received the highest score for challenge, it still received the lowest overall experience score due to variable weighting. Specifically, this section's challenge score was offset by its low score for tread aesthetics, which had significantly more influence on the overall experience score. Section 9 explicitly displays the high level of importance tread aesthetics has to long-distance hikers. This section was shown

to have high incision, mud, width, rugosity, and uphill (Table 1), which all factored into Section 9 receiving the lowest score for tread aesthetics.

Section 14 is located in northern Maine in Baxter State Park. This section received the highest score for tread aesthetics, which influenced its high overall experience score. This section had low scores for incision, mud, and rugosity (Table 1), which contributed to this section receiving the highest score for tread aesthetics. The findings for this section align with the regulations at Baxter State Park, which has stricter conservation rules than many of America's national parks (Baxter State Park, 2012; Irland, 1991; Lemons & Stout, 1984). At Baxter State Park conservation regulations take precedence over accessibility, and it appears that management objectives and associated management practices help keep the trails in a highly preferable condition, enhancing tread aesthetics, and maintaining high-quality hiking experience. This section's high scores display Baxter State Park's priority towards the trail and associated conservation.

It is beneficial for managers to compare trail sections. Managers of other trail sections may want to compare their trail section to the section in Baxter State Park to determine how to enhance the overall experience. Likewise, managers may also want to compare their section to the section in Grafton Notch State Park to gain understanding of conditions that may potentially detract from the hiking experience, but also increase level of challenge.

### Future Research and Limitations

Although this research identified the relationships between trail conditions and experiential elements of long-distance hiking, limitations do exist. First, this research only analyzed 21 trail sections of the AT. Although this equates to approximately 65

miles, it is not enough information to label vast parts of the AT, such as an entire state. Another limitation is that social validation of the data has not occurred. Through interviews with long-distance hikers, it is possible to validate the findings in this research. For example, researchers can interview long-distance hikers at a specific location to identify if the findings from this study align with the sentiment of the hiker. Lastly, this research only focused on ‘tread aesthetics’, not the visual aesthetics that surround the trail, which may include vegetation type and density, color variation, and vistas. As a result, future research should address these limitations.

Further research can refine the methods used in this study. For example, instead of assigning a score for an entire 5-kilometer section of trail, each transect essentially has an individual social preference score. Therefore, future research could demonstrate how changes occur throughout a section using transect data aligned with social preference data (this study took measurements at 50 transect points within each 5-kilometer section of trail sampled). Assigning more transect points per section would allow for an even more detailed analysis. Further research could also use these methods to dissect the differences in the age of hikers (young hikers vs. senior citizen hikers) or between males and females to see the differences in the relationships between trail conditions and elements of the hiking experience between groups. Managers would also benefit from conducting this research in the northbound and southbound hiking directions on the AT.

Even though the purpose of this study was to map experiences along the AT, this could be viewed as a downside to the capabilities of RSM. It could be argued that further mapping of high-use areas, such as the Appalachian Trail, may take away from user experience, because further mapping may prevent user discovery while recreating. However, the information provided by this study is useful for planning hikes along the

AT and knowing what type of experience to plan for. Even though a section may be labeled as providing a specific experience, that experience cannot be discovered until the user is on the trail and feeling the sensations and emotions that are born from hiking the trail.

### Conclusion

Analyzing the relationships between trail conditions and experiential elements is an important new method for integrating the resource and experiential components of outdoor recreational experiences. This research serves as a foundational component investigating and mapping the relationships between trail conditions and experiential elements of long-distance hiking. Long-distance hiking trails are an expansive natural resource, and there must be continued evaluation of the sustainability of these massive and grand resources, and further understanding of the population hiking these trails.

Table 1. *Average trail conditions in each section*

Section ID	Incision (mm)	Muddiness (%)	Width (mm)	Rugosity (mm <sup>2</sup> )	Uphill (ft)	Downhill (ft)
6 – CT	88.46	0	869.94	1625.30	1193	1134
11 – MA	35.67	0	878.37	462.26	344	350
17 – MA	75.39	0	375.00	1033.27	912	780
21 – MA	68.40	0	882.08	1198.27	563	534
4 – MA	59.14	2.4	548.84	906.27	1594	115
19 – VT	63.62	0	604.17	827.13	1199	867
12 – VT	69.24	4.69	654.86	975.31	338	1114
5 – NH	63.58	3.85	706.79	749.96	715	836
13 – NH	73.83	4.69	743.78	1561.91	389	1552
18 – NH	59.82	3.98	616.23	806.52	458	1557
3 – NH	161.15	0	1451.67	3704.52	1430	1001
8 – NH	79.93	0.91	1083.32	1198.51	1942	192
9 – ME	164.59	3.88	999.49	3771.48	2285	466
16 – ME	73.52	2.95	672.43	1150.35	1505	377
15 – ME	134.57	1.74	720.98	16143.18	1108	625
7 – ME	54.62	5.00	742.60	576.70	614	183
20 – ME	62.62	3.20	786.44	817.68	872	956
2 – ME	64.10	6.50	747.10	632.19	890	876
10 – ME	53.00	2.17	980.63	404.97	337	534
1 – ME	44.77	1.04	602.92	471.86	681	546
14 – ME	28.46	0	622.89	216.81	1639	225
F-Value	5.48***	9.64***	1.74*	2.04***	$\chi^2 = 220$ ***	$\chi^2 = 119$ ***

*Note.* Incision average reported in millimeters. Muddiness averaged from the percent of mud found across the transect line. Rugosity average reported in millimeters. Uphill and downhill reported as the total uphill and downhill for each section in feet traveling north on the AT. \* $p < 0.05$ ; \*\*\* $p < 0.001$ .

Table 2. *Section scores for each experiential element of long-distance hiking and overall hiking experience*

Section ID	Challenge	Aesthetics	Pace	Impact	Overall
6 – CT	4.44	4.25	3.89	3.26	4.41
11 – MA	2.74 <sup>b</sup>	5.29	5.61 <sup>a</sup>	5.35	5.11
17 – MA	3.77	5.12	4.65	4.22	5.19
21 – MA	3.35	4.71	4.89	4.59	4.62
4 – MA	4.49	4.47	4.32	5.06	4.72
19 – VT	4.07	5.02	4.58	4.14	5.18
12 – VT	3.12	3.57	3.73	3.44	3.20
5 – NH	3.45	3.87	4.03	3.99	3.67
13 – NH	3.51	3.22	3.09	2.44	2.89
18 – NH	3.28	3.88	3.66	2.86	3.57
3 – NH	5.59	2.35	2.48	2.27 <sup>b</sup>	2.63
8 – NH	5.06	4.00	4.14	4.76	4.40
9 – ME	6.65 <sup>a</sup>	1.61 <sup>b</sup>	1.53 <sup>b</sup>	2.64	2.12 <sup>b</sup>
16 – ME	4.53	3.94	3.89	4.45	4.12
15 – ME	5.25	2.90	2.51	2.77	3.11
7 – ME	3.14	3.74	4.37	5.07	3.46
20 – ME	3.69	3.94	3.98	3.79	3.82
2 – ME	3.66	3.07	3.39	3.73	2.82
10 – ME	2.76	4.36	4.97	4.85	4.05
1 – ME	3.21	5.11	5.07	4.87	5.02
14 – ME	4.25	5.57 <sup>a</sup>	5.21	5.46 <sup>a</sup>	5.90 <sup>a</sup>

Note. Scores scaled from ‘1’ (not preferable) to ‘7’ (highly preferable); scores denoted with <sup>a</sup> represent the high score, and scores denoted with <sup>b</sup> represent the low score in each column.





*Figure 1.* Trail conditions

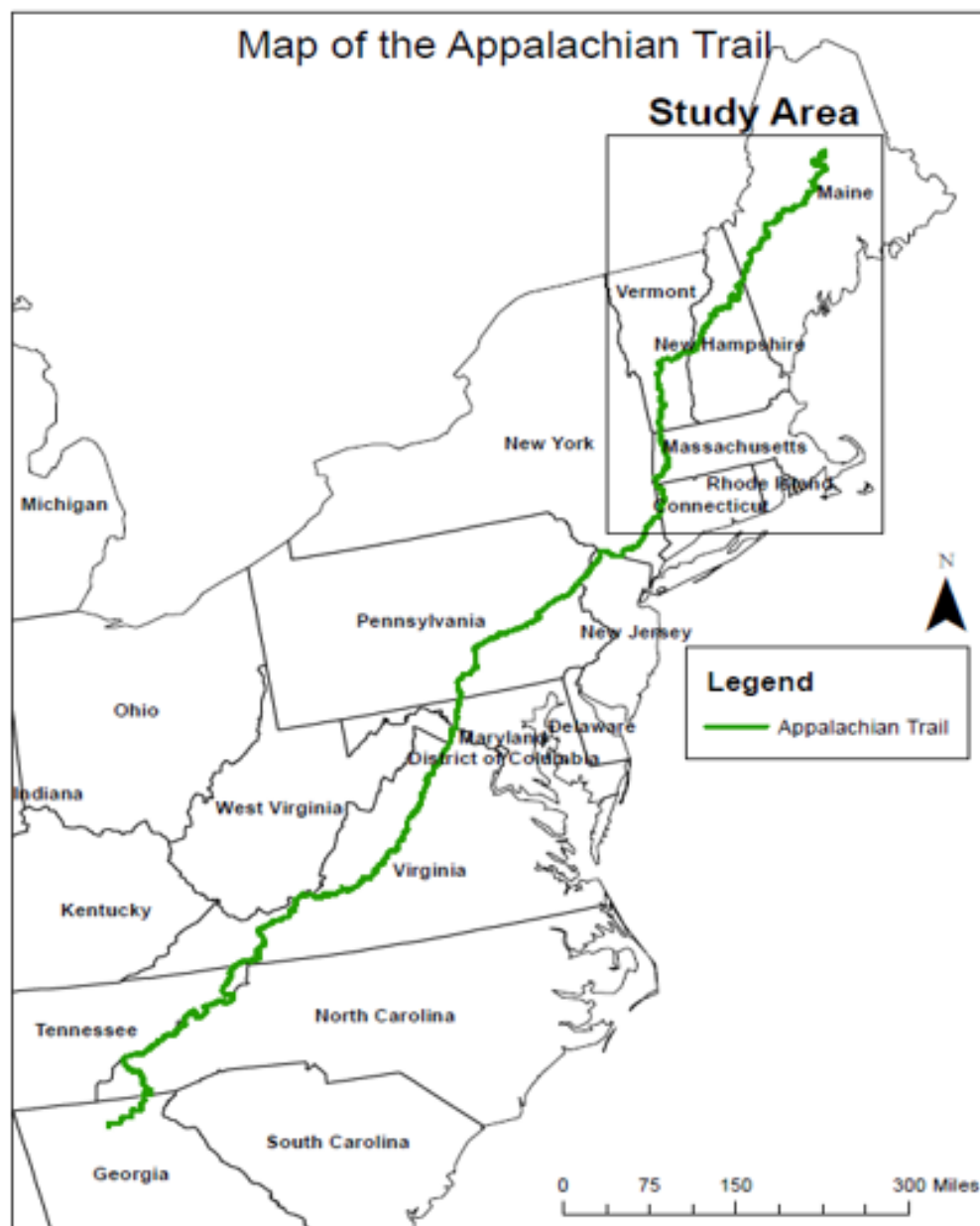
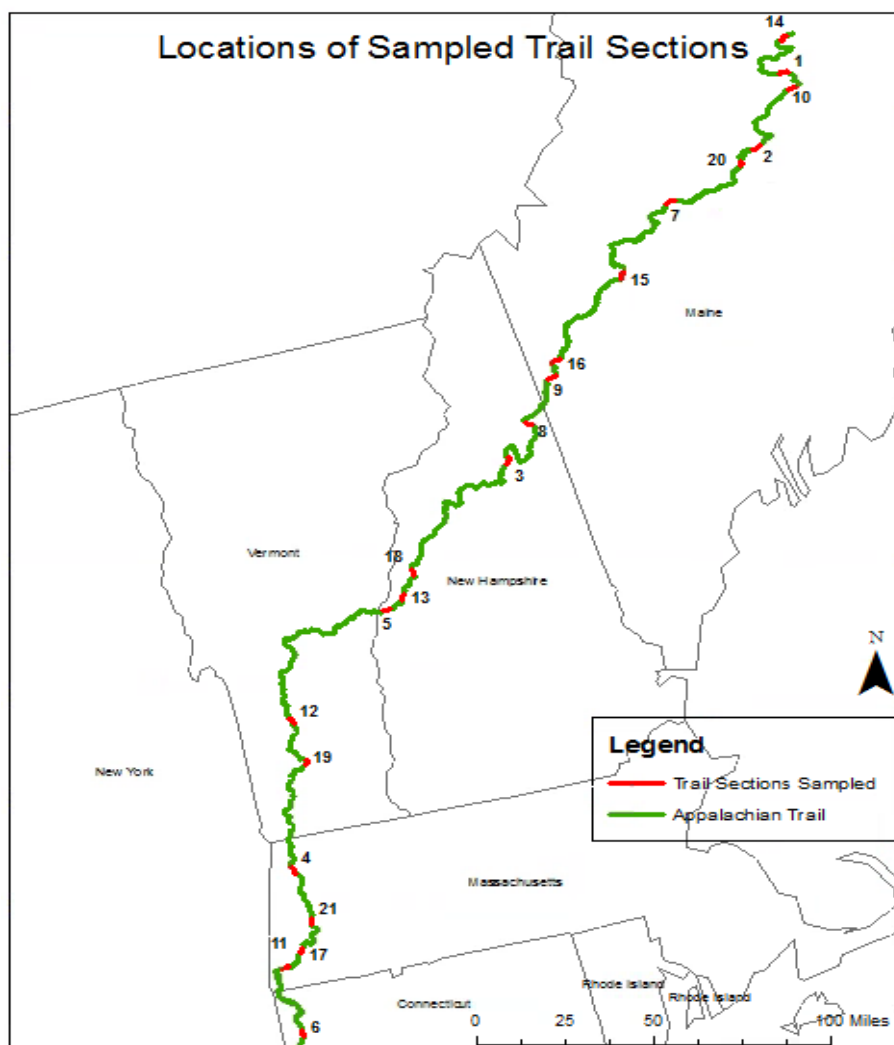


Figure 2. Map of the Appalachian Trail and study area



*Figure 3.* Map of Appalachian centerline in green and the location of the 21 sections in red; 1 section in Connecticut, 4 in Massachusetts, 2 in Vermont, 5 in New Hampshire, and 9 in Maine.

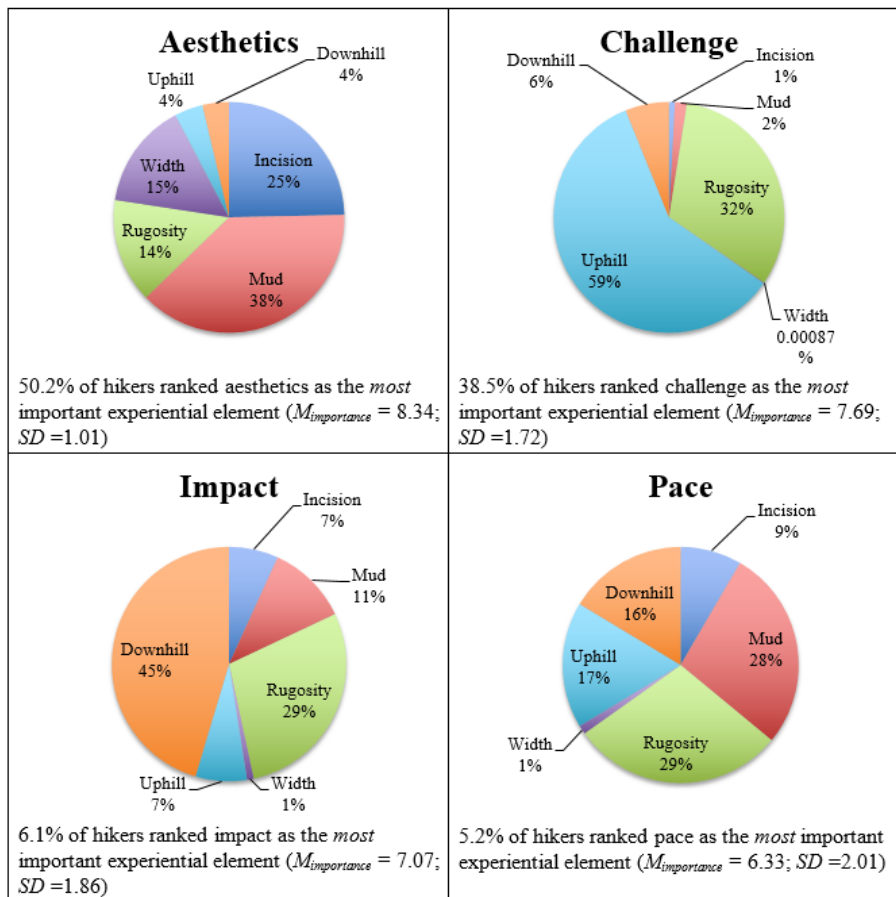
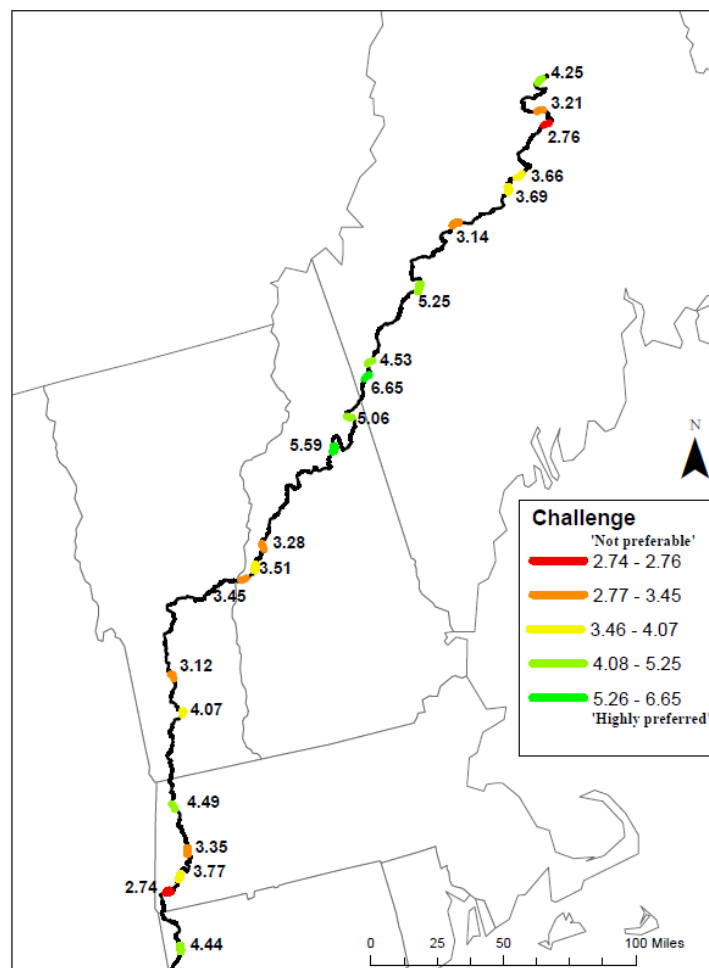


Figure 4. The influence of each trail condition to each experiential element of long-distance hiking.  $M_{importance}$  derived from a 9-point Likert scale anchored with 1 = 'not important at all' and 9 = 'extremely important', in respect to the importance of the experiential element to the overall long-distance hiking experience.



*Figure 5.* Map layer for level of challenge. Scores scaled from '1' (not preferable) to '7' (highly preferable).

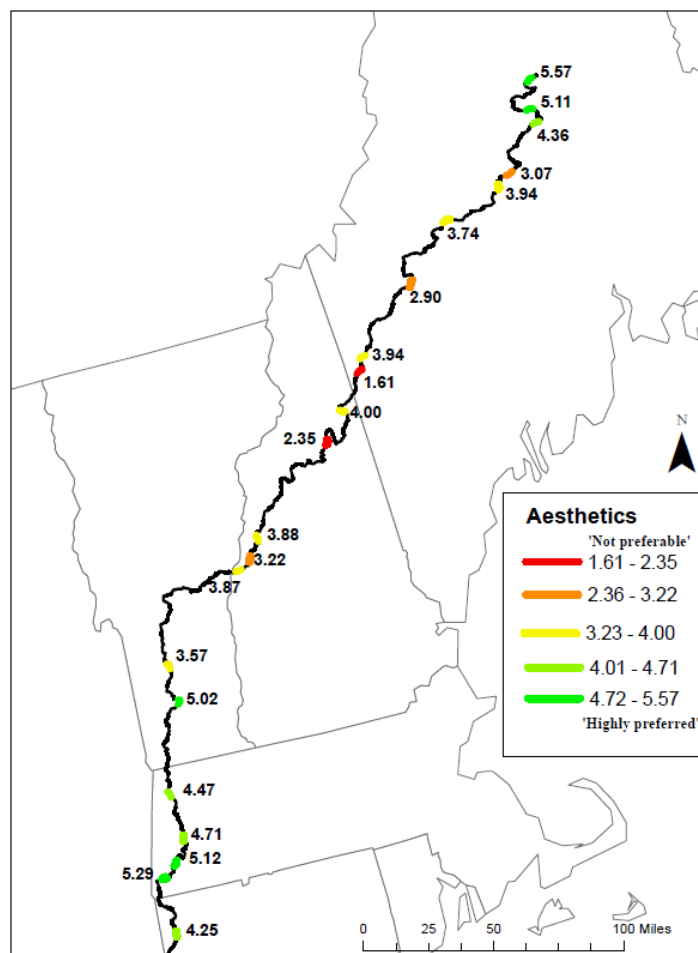
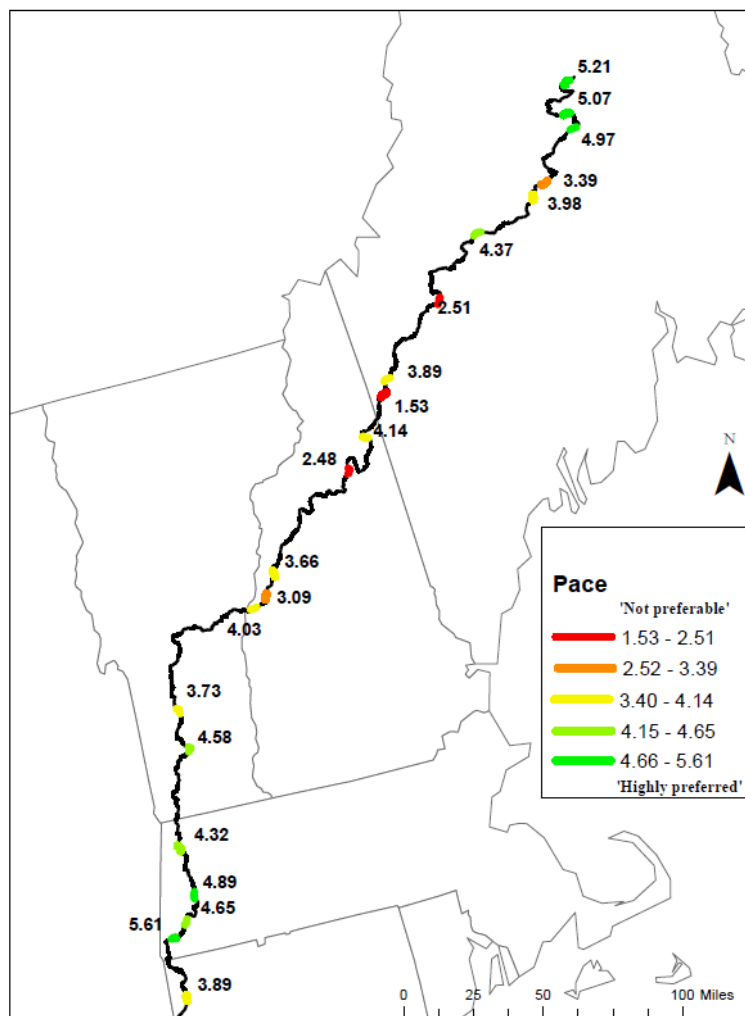
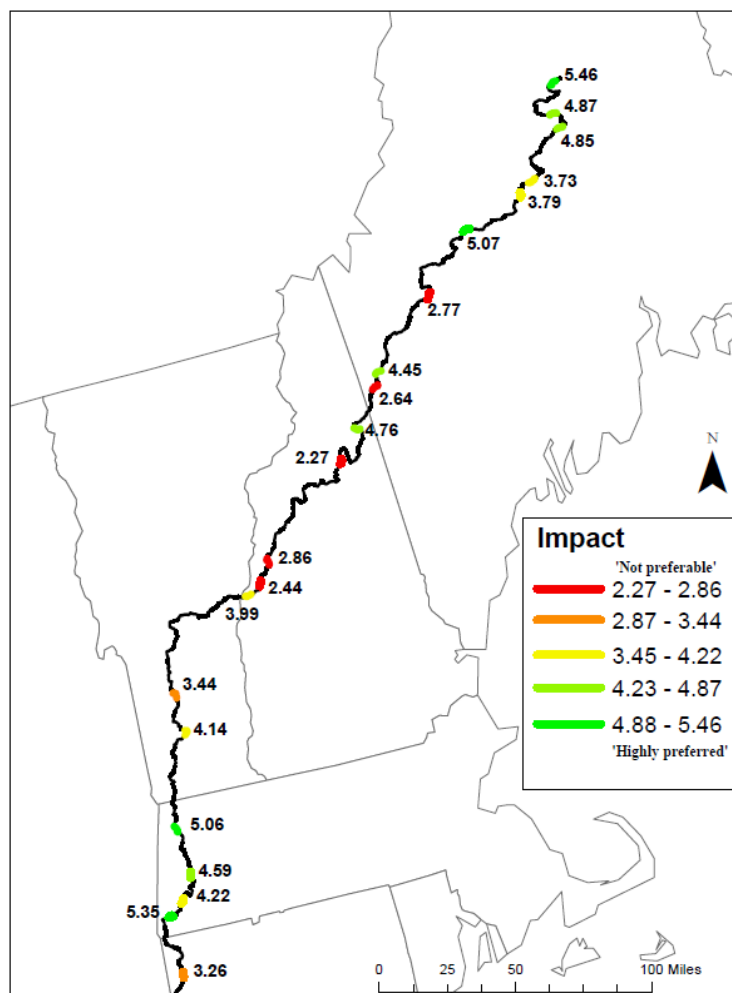


Figure 6. Map layer for valuation of trail aesthetics. Scores scaled from '1' (not preferable) to '7' (highly preferable).



*Figure 7.* Map layer for the ability to maintain an ideal hiking pace. Scores scaled from '1' (not preferable) to '7' (highly preferable).



*Figure 8.* Map layer for perceived impact to the musculoskeletal system. Scores scaled from '1' (not preferable) to '7' (highly preferable).



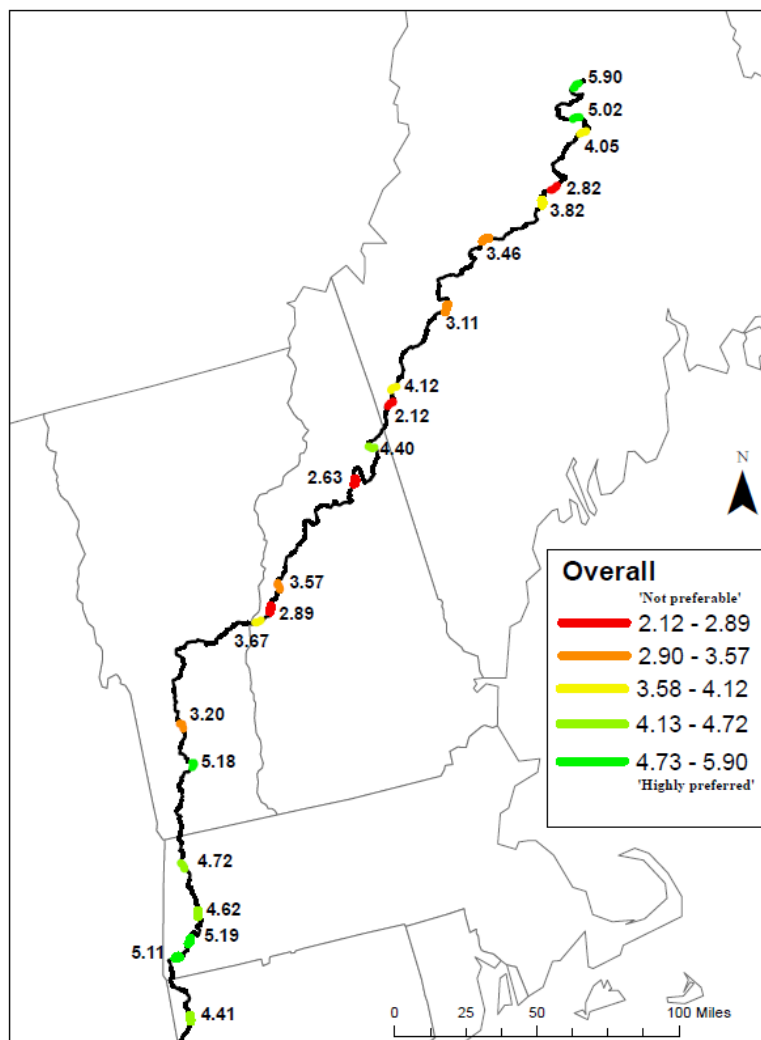


Figure 9. Map layer for overall experience. Scores scaled from '1' (not preferable) to '7' (highly preferable).

## CHAPTER III

### SUMMARY AND CONCLUSIONS

#### Reflections on Learning

##### Introduction

The intention of this section is to review the thesis experience and share the challenges, successes, and discoveries that occurred during the process, as well as offer advice to other students. The “reflections on learning” section accounts for the entire thesis progression and is an honest reflection of the process. This section presents the insights gained through all of the successes and failures. The following paragraphs explore what I have learned about research, writing, and myself during the entire thesis process.

##### Challenges

Challenges began at the contemplation stage. I began my master’s program excited about studying the sustainability of long-distance hiking trails, and I wanted to somehow incorporate GIS into my research; however, this idea needed to be narrowed. My broad idea was narrowed through meetings with my advisor and through a review of the literature. As my topic narrowed, I began forming research questions that I was interested in investigating.

A major concern with my thesis was applying GIS techniques. Before returning to graduate school, I had never taken a GIS class. I took one GIS class each semester during my studies. With each class, I purposely established relationships with each GIS professor so that I felt comfortable contacting them with questions about my thesis. I committed myself to setting up meetings with the GIS professors and discussing my thesis. My resulting GIS network was exceedingly beneficial towards helping me when I encountered a GIS problem.

I also had apprehensions about my writing ability. I had been out of school for 10 years, and I lacked confidence in my writing. It was evident that I did not know how to write a technical manuscript as I began writing my thesis. With humble acknowledgement of this issue, I pursued the improvement of my writing skills. I learned about writing through reading manuscripts, and discussing writing during meetings with my advisor. I also met with current PhD students in my program to discuss writing.

Trials also arose while distributing questionnaires, which included having to work through emotions stemming from rejection when people declined to participate in the research, and even when some people were rude. While sampling, some of the comments people made were discouraging, which gave me a skewed perspective about what the results may reveal. In reality, the comments came from a small percentage of people completing the questionnaire and did not influence the results.

### Successes

The greatest success of the thesis process was the development of creative problem solving skills. On several occasions, I was confronted with a complex problem. I quickly learned that it was not wise to set the problem aside. Instead, it was better to

immediately seek assistance. I found that I was able to solve those problems that I initially perceived as unsolvable. Seeking help typically began with a meeting with my advisor to discuss the problem. This was productive because it helped me fully understand the scope of the problem. From there I would discuss the problem with committee members, other professors, and students.

During the thesis process, there were many low points that tested my mettle. Had I not been passionate about my topic, it would have been easy to give up, or take shortcuts. Shortcuts would have compromised my learning objectives, and decreased the quality of my thesis. My passion for the topic helped me explore many curiosities, and ultimately persevere.

### Discoveries

The overall learning from this study includes its major findings. It is exciting that further research can build upon this study. It is also exciting to write about possible management implications stemming from this research. I am also excited to see that the methods developed in this study are transferable to other settings and populations.

The small discoveries encountered during this thesis were just as important. For example, I discovered that I needed to develop an outline for all writing endeavors. This discovery became evident when attempting to write the first draft of my proposal. I now practice drafting outlines before all writing projects.

I also discovered what it meant to maintain integrity as a scientist. I discussed this topic with my advisor and other students, but had never experienced it. I found that there were many opportunities while doing research to solve problems using methods that lack integrity. For example, when I realized I forgot to record the exact response rate while

distributing questionnaires, I could have easily made up the response rate, but that was not the type of scientist I wanted to be, and doing this would have violated my ethical standards. All facets of this research were thus carried out with utmost integrity and reflected the professionalism of my advisor, my committee members, the University of Utah, and myself.

### Advice

I learned that time management is key in conducting successful research. During the research process, unforeseen problems arise. There needs to be enough time to properly tend to these problems and learn from these problems, so that the lessons learned can be properly applied. Time management is also extremely important during the writing process. Effective writing requires substantial revisions. The writing process is not only the physical writing up of the research results, but also the time needed for reflection and evaluation of the research. Rushing through the writing process can result in errors that may reflect poorly on the researcher.

It is also important to maintain a humble attitude throughout the thesis process. Humility aids in learning, and increases willingness to seek assistance when needed. Through humility, you can identify where your weaknesses are and tend to them. Mistakes are going to occur as part of the process, and solving them in a professional manner, with utmost integrity, is the best method to develop as a scientist.

My passion for this thesis topic has fueled the process. The process took longer than expected, and it took loving my topic to persevere. The intense analysis of my topic would have made it easy to give up on if I had not been passionate about the subject. My

passion for my topic and my field kept my dedication and integrity high. Do not settle on a topic for convenience.

## APPENDIX A

### INITIAL INTERVIEW QUESTIONS

The initial interview was designed using a modified Seidman Approach (Seidman, 2012). The interview is broken up into three phases: focused history, perceptions, and summary.

Purpose: To determine and verify salient elements of the hiking experience of AT long-distance hikers.

#### **INITIAL QUESTIONS**

1. Do you mind if I record the interview with you?
2. Did you read the consent form I emailed you?

#### **FOCUSED HISTORY**

1. What draws you to long-distance backpacking?
2. What year did you do your first long-distance backpacking trip?
3. What long-distance backpacking trips have you done?

#### **PERCEPTIONS OF INDICATORS OF QUALITY**

1. Why do you go on long-distance backpacking trips?
2. What makes for a quality experience?
3. What makes a long-distance backpacking trip successful?
4. What measures do you use to determine if you had a good day backpacking?
5. What makes the AT special?

#### **SUMMARY**

1. Have factors leading to quality of experience ever changed for you?
2. If so, how did they change, and why did they change?
3. Please sum up what factors are essential to a great experience on the AT.
4. Anything you have not told me that contributes to a quality experience on the AT?
5. What is your definition of a long-distance hiker?

## APPENDIX B

### IRB STATEMENT

3/3/2016

IRB Statement.html



## INSTITUTIONAL REVIEW BOARD

### THE UNIVERSITY OF UTAH

75 South 2000 East Salt Lake City, UT 84112 | 801.581.3655 | IRB@utah.edu

**IRB:** [IRB\\_00081939](#)

**PI:** Brian Peterson

**Title:** The relationships between trail conditions and experiential elements of the long-distance hiking experience on the northern section of the Appalachian Trail

Thank you for submitting your request for approval of this study. On 5/12/2015, a designated IRB member has determined that your study is exempt from further IRB review, under **Exemption Category 2**. Note the following delineation of categories:

- Categories 1-6: Federal Exemption Categories defined in 45 CFR 46.101(b)
- Categories 7-11: Non-Federal Exemption Categories defined in University of Utah IRB policy at [http://irb.utah.edu/\\_pdf/IGS-Exempt\\_Research\\_090113.pdf](http://irb.utah.edu/_pdf/IGS-Exempt_Research_090113.pdf)

You must adhere to all requirements for exemption described in University of Utah IRB policy ([http://irb.utah.edu/\\_pdf/IGS-Exempt\\_Research\\_090113.pdf](http://irb.utah.edu/_pdf/IGS-Exempt_Research_090113.pdf)). This includes:

- All research involving human subjects must be approved or determined exempt by the IRB before the research is conducted.
- All research activities must be conducted in accordance with the Belmont Report and must adhere to principles of sound research design and ethics.
- Orderly accounting and monitoring of research activities must occur.

#### Ongoing Submissions for Exempt Projects

- **Continuing Review:** Since this determination is not an approval, the study does not expire or need continuing review. This determination of exemption from continuing IRB review only applies to the research study as submitted to the IRB. You must follow the protocol as proposed in this application to the IRB to secure either approval or a determination of exemption. **Investigators should contact the IRB Office if there are questions about whether an amendment consists of substantive changes.** Substantive changes include, but are not limited to
  - Changes that increase the risk to participants or change the risk:benefit ratio of the study
  - Changes that affect a participant's willingness to participate in the study
  - Changes to study procedures or study components that are not covered by the Exemption Category determined for this study (listed above)
  - Changes to the study sponsor
  - Changes to the targeted participant population
  - Changes to the stamped consent document(s)
- **Report Forms:** Exempt studies must adhere to the University of Utah IRB reporting requirements for unanticipated problems and deviations: <http://irb.utah.edu/submit-application/forms/index.php>
- **Final Project Reports for Study Closure:** Exempt studies must be dosed with the IRB once the research activities are complete: <http://irb.utah.edu/submit-application/final-project-reports.php>

If you have questions about this, please contact our office at 581-3655 and we will be happy to assist you. Thank you again for submitting your proposal.

Click [IRB\\_00081939](#) to view the application.

Please take a moment to complete our [customer service survey](#). We appreciate your opinions and feedback.



## APPENDIX C

### QUESTIONNAIRE

#### **Long-distance hikers' perceptions of trail conditions**

Important questions for long-distance hikers on the Appalachian Trail



The purpose of this study is to evaluate long-distance hikers' opinions about trail conditions with the intent of informing management decisions regarding the Appalachian Trail.

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Conducted by



**Outdoor Recreation, Education, & Tourism Lab**  
COLLEGE OF HEALTH | THE UNIVERSITY OF UTAH

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archer use only:

Time \_\_\_\_\_ Date \_\_\_\_\_ Survey Staff \_\_\_\_\_ Comments \_\_\_\_\_

Throughout this questionnaire, we use the abbreviation “AT” to refer to the Appalachian Trail. After you complete this questionnaire, please return it to the field researcher. All responses are confidential and anonymous. Thank you for your cooperation.

Please tell us about your past hiking experience.

1. Approximately how many miles have you hiked on any trails during...
  - a. The last year (12 months)? \_\_\_\_\_ # of miles
  - b. The last three years (36 months)? \_\_\_\_\_ # of miles
  - c. Your lifetime? \_\_\_\_\_ # of miles
  
2. Which, if any, of the following long-distance hiking trails have you hiked more than 500 miles?
 

☐ Pacific Crest Trail  
☐ Other (please specify \_\_\_\_\_)

☐ Continental Divide Trail

Please tell us about your past AT hiking experience.

3. Approximately how many miles have you hiked on the AT during...
  - a. The last month (30 days)? \_\_\_\_\_ # of miles
  - b. The last three years (36 months)? \_\_\_\_\_ # of miles
  - c. During your lifetime? \_\_\_\_\_ # of miles

**The following questions ask about your preferences for AT conditions and different AT hiking experiences. In order to understand the specific AT conditions referenced in the following questions, please refer to the photograph sheet provided by the field researcher. It may be helpful to review these photographs frequently while answering the questions.**



We would like to know which AT trail conditions you prefer related to different AT hiking experiences. A rating of - 4 indicates that you 'do not prefer' the condition and + 4 means that you 'highly prefer' the condition. *Circle one number for each row.*

1. In order to <b>challenge myself</b> , I prefer....	Do not prefer	Highly prefer
a <u>rough trail</u> with exposed rocks and roots	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail with many <u>muddy spots</u>	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail <u>wide</u> enough for two people	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail that is <u>deeper</u> in the middle than the sides	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>uphill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>downhill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
2. For <b>trail beauty</b> , I prefer....	Do not prefer	Highly prefer
a <u>rough trail</u> with exposed rocks and roots	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail with many <u>muddy spots</u>	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail <u>wide</u> enough for two people	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail that is <u>deeper</u> in the middle than the sides	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>uphill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>downhill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
3. In order to achieve and maintain my ideal <b>hiking pace</b> , I prefer....	Do not prefer	Highly prefer
a <u>rough trail</u> with exposed rocks and roots	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail with many <u>muddy spots</u>	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail <u>wide</u> enough for two people	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail that is <u>deeper</u> in the middle than the sides	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>uphill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>downhill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
4. In order to avoid <b>undesirable impact to my body</b> , I prefer....	Do not prefer	Highly prefer
a <u>rough trail</u> with exposed rocks and roots	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail with many <u>muddy spots</u>	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail <u>wide</u> enough for two people	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail that is <u>deeper</u> in the middle than the sides	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>uphill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>downhill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
5. Regarding my <b>overall AT hiking experience</b> , I prefer....	Do not prefer	Highly prefer
a <u>rough trail</u> with exposed rocks and roots	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail with many <u>muddy spots</u>	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail <u>wide</u> enough for two people	-4 -3 -2 -1 0 +1 +2 +3 +4	
a trail that is <u>deeper</u> in the middle than the sides	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>uphill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	
hiking <u>downhill</u> at more than a 15% slope	-4 -3 -2 -1 0 +1 +2 +3 +4	

Please tell us which AT trail conditions are most important to you as they relate to different AT hiking experiences. *Check one box to complete each statement.*

<i>Check only one box for each statement</i>	
<b>1. The trail condition that <u>most</u> allows me to challenge myself is....</b>	
a <u>rough trail</u> with exposed rocks and roots	<input type="checkbox"/>
a trail with many <u>muddy</u> spots	<input type="checkbox"/>
a trail <u>wide</u> enough for two people	<input type="checkbox"/>
a trail that is <u>deeper</u> in the middle than the sides	<input type="checkbox"/>
hiking <u>uphill</u> at more than a 15% slope	<input type="checkbox"/>
hiking <u>downhill</u> at more than a 15% slope	<input type="checkbox"/>
<b>2. The trail condition that <u>most</u> detracts from a beautiful AT is....</b>	
a <u>rough trail</u> with exposed rocks and roots	<input type="checkbox"/>
a trail with many <u>muddy</u> spots	<input type="checkbox"/>
a trail <u>wide</u> enough for two people	<input type="checkbox"/>
a trail that is <u>deeper</u> in the middle than the sides	<input type="checkbox"/>
hiking <u>uphill</u> at more than a 15% slope	<input type="checkbox"/>
hiking <u>downhill</u> at more than a 15% slope	<input type="checkbox"/>
<b>3. The trail condition that <u>most</u> negatively influences my ideal hiking pace is...</b>	
a <u>rough trail</u> with exposed rocks and roots	<input type="checkbox"/>
a trail with many <u>muddy</u> spots	<input type="checkbox"/>
a trail <u>wide</u> enough for two people	<input type="checkbox"/>
a trail that is <u>deeper</u> in the middle than the sides	<input type="checkbox"/>
hiking <u>uphill</u> at more than a 15% slope	<input type="checkbox"/>
hiking <u>downhill</u> at more than a 15% slope	<input type="checkbox"/>
<b>4. The trail condition that <u>most</u> negatively affects my body is....</b>	
a <u>rough trail</u> with exposed rocks and roots	<input type="checkbox"/>
a trail with many <u>muddy</u> spots	<input type="checkbox"/>
a trail <u>wide</u> enough for two people	<input type="checkbox"/>
a trail that is <u>deeper</u> in the middle than the sides	<input type="checkbox"/>
hiking <u>uphill</u> at more than a 15% slope	<input type="checkbox"/>
hiking <u>downhill</u> at more than a 15% slope	<input type="checkbox"/>
<b>5. The trail condition that <u>most</u> negatively influences my overall AT hiking experience is....</b>	
a <u>rough trail</u> with exposed rocks and roots	<input type="checkbox"/>
a trail with many <u>muddy</u> spots	<input type="checkbox"/>
a trail <u>wide</u> enough for two people	<input type="checkbox"/>
a trail that is <u>deeper</u> in the middle than the sides	<input type="checkbox"/>
hiking <u>uphill</u> at more than a 15% slope	<input type="checkbox"/>
hiking <u>downhill</u> at more than a 15% slope	<input type="checkbox"/>

Please tell us how important the following AT hiking experiences are to you. A rating of - 4 indicates that the experience is 'not important at all' and + 4 means that the experience is 'extremely important.' *Circle one number for each row.*

1. Regarding <u>your</u> overall AT hiking experience, how important is the opportunity to...	Not important at all					Extremely important				
challenge yourself	-4	-3	-2	-1	0	+1	+2	+3	+4	
view a beautiful trail	-4	-3	-2	-1	0	+1	+2	+3	+4	
achieve and maintain your ideal hiking pace	-4	-3	-2	-1	0	+1	+2	+3	+4	
avoid undesirable impact to your body	-4	-3	-2	-1	0	+1	+2	+3	+4	

We would like to know which hiking experience is the most important to you. Entering '1' indicates that the experience is 'most important' and '4' indicates that experience is 'least important.' *Enter one number for each row.*

		<i>Enter one number for each row</i>	
		<b>1 = most important</b> <b>2 = 2<sup>nd</sup> most important</b> <b>3 = 3<sup>rd</sup> most important</b> <b>4 = least important</b>	
2. Rank what is most important to <u>your</u> overall AT hiking experience			
Opportunity to <u>challenge myself</u>		_____	
Opportunity to <u>view a beautiful trail</u>		_____	
Opportunity to <u>achieve and maintain my ideal hiking pace</u>		_____	
Opportunity to <u>avoid undesirable impact to my body</u>		_____	

Please tell us how important the following are to you. A rating of - 4 indicates that the experience is 'not important at all' and + 4 means that the experience is 'extremely important.' *Circle one number for each row.*

3. How important are the following?	Not important at all					Extremely important				
Overall sustainability of the AT	-4	-3	-2	-1	0	+1	+2	+3	+4	
Number of other hikers you encounter on the AT	-4	-3	-2	-1	0	+1	+2	+3	+4	
Type of hikers you encounter on the AT	-4	-3	-2	-1	0	+1	+2	+3	+4	
The social atmosphere	-4	-3	-2	-1	0	+1	+2	+3	+4	
Ecological integrity of the AT	-4	-3	-2	-1	0	+1	+2	+3	+4	
Flora and fauna of the AT	-4	-3	-2	-1	0	+1	+2	+3	+4	

1. Do you consider yourself a.... *(check one)*

- |  |  |
|--|--|
| <input type="checkbox"/> 2015 north bound thru-hiker | <input type="checkbox"/> Past north bound thru-hiker (Specify year_____) |
| <input type="checkbox"/> 2015 south bound thru-hiker | <input type="checkbox"/> Past south bound thru-hiker (Specify year_____) |
| <input type="checkbox"/> 2015 section-hiker          | <input type="checkbox"/> Past section-hiker (Specify year_____)          |

2. What is the zip code of your primary residence? \_\_\_\_\_

3. In what year were you born? \_\_\_\_\_

4. What is your gender? *(check one)*      ☐ Male      ☐ Female

5. What is the highest level of school you have completed? *(check one)*

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> Less than high school | <input type="checkbox"/> Some college               | <input type="checkbox"/> Graduate or professional degree |
| <input type="checkbox"/> Some high school      | <input type="checkbox"/> Two-year college graduate  | <input type="checkbox"/> Do not wish to answer           |
| <input type="checkbox"/> High school graduate  | <input type="checkbox"/> Four-year college graduate |  |

6. What is your race/ethnicity? *(check all that apply)*

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> American Indian or Alaska Native | <input type="checkbox"/> Hawaiian or Pacific Islander | <input type="checkbox"/> Other                 |
| <input type="checkbox"/> Asian                            | <input type="checkbox"/> Hispanic or Latino/Latina    | <input type="checkbox"/> Do not wish to answer |
| <input type="checkbox"/> Black or African American        | <input type="checkbox"/> White                        |  |

7. Which category best describes your total household income in U.S. dollars during 2014 before taxes? *(check one)*

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> Less than \$24,999   | <input type="checkbox"/> \$50,000 to \$74,999   | <input type="checkbox"/> \$150,000 to \$199,999 |
| <input type="checkbox"/> \$25,000 to \$34,999 | <input type="checkbox"/> \$75,000 to \$99,999   | <input type="checkbox"/> \$200,000 or more      |
| <input type="checkbox"/> \$35,000 to \$49,999 | <input type="checkbox"/> \$100,000 to \$149,999 | <input type="checkbox"/> Do not wish to answer  |

8. Please provide any additional comments about the management of the Appalachian Trail.

**Thank you for your help!** If you have questions regarding this study, please contact:

Matthew Brownlee, Ph.D. | matthew.brownlee@hsc.utah.edu | 801-585-7239 | University of Utah

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